

# Antenna Support Structures For The Common Man—How To Build A Tower With Only \$500

***Proven Tips For Putting Steel In The Sky Without Spending A Small Fortune***

by Ken J. Meyer, K9KJM

**A**lmost everyone who's been in the radio business or hobby for any length of time knows that a radio station is only as good as its antenna system. And for that system to be much good, the antennas usually need to be mounted high above the surrounding area. That eventually leads radio communication enthusiasts to say to themselves "I sure wish I had that in my backyard" whenever they pass some tall commercial-type radio tower.

As much as we'd like to have a big tower in our backyards (or even a tripod and mast on the roof), there are a number of potential roadblocks that must be overcome to get the tallest and best antenna support structure, or "tower," possible. Lack of funds can definitely be a big roadblock. But it doesn't have to be that way; you just need to make the most of something called a "Resource Triangle."

## Geometry Is Your Friend

Years ago I heard how any project can be accomplished with the right combination of elements—to your Resource Triangle, that is, with the three points being TIME, MONEY, and SKILL. That triangle can be adjusted any which way. If you have lots of time and skill, you can succeed at most any project with very little money. Or, if you have lots of time, but very little skill and money, the project still can be accomplished; it will just take much longer. You get the idea. The exception of course is money. If you have boatloads of money, you can get by without a lot of either skill or time; you can just hire it all out!

*Think small...An example of an old TV tower recycled to a 50-foot Rohn 25 tower holding up 11-meter CB antennas.*

Kenneth J. Meyer, K9KJM, has been a life-long communications enthusiast. In addition to his Extra class ham license, Ken also has an FCC GMRS license, operates an FCC licensed VHF commercial radio system, and provides technical support to various radio communications systems. He currently has seven towers in his backyard.



As mentioned, the expense connected with a tower is an obstacle for many; it certainly has been for me! So over the years I found many ways to use time and skill to accomplish a goal like getting a decent tower without breaking the bank.

## If You Can Build A Backyard Swing Set, You Can Probably Do This, Too

To build your own tower, you must first determine if the law is on your side. There are a few key questions to ask yourself: Do you own the property in question, or rent? If a renter, you need to check with

the landlord. If you're a homeowner, is there a (dreaded!) homeowner association private agreement with restrictions on your property? Then there's the FAA. Are you near an airport or under a flight path?

You also need to check with the local zoning or planning department. Most rural areas have almost no regulations for non-commercial towers, but some cities and villages do have restrictive ordinances that need to be addressed. Note that even if there is some type of local ordinance restricting your plans, if you're a ham you have PRB-1 (a federal law you can read more about at [http://wireless.fcc.gov/services/index.htm?job=prb-](http://wireless.fcc.gov/services/index.htm?job=prb-1&id=amateur&page=1)

[1&id=amateur&page=1](http://wireless.fcc.gov/services/index.htm?job=prb-1&id=amateur&page=1)) working in your favor. The threat of a federal lawsuit usually will work magic in getting the local zoning board to see things your way, or at least in being willing to compromise on the height of the tower allowed.

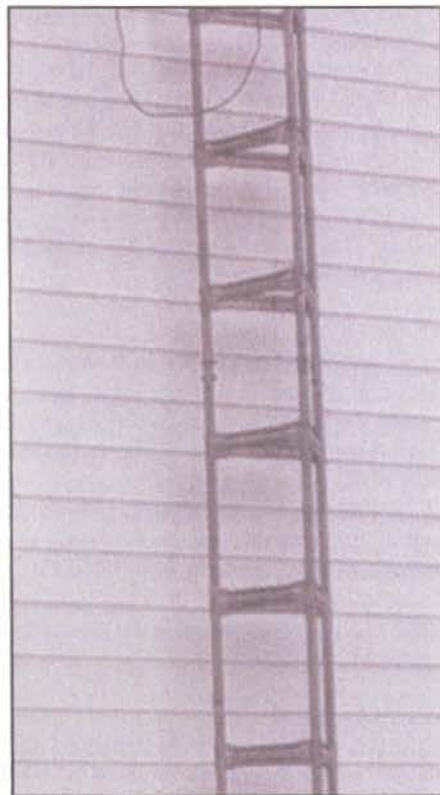
All these rules and regulations may have some people saying, "The heck with it, I don't need a tower that bad," or you may be tempted to think, "My little 30-foot mast will go unnoticed." To the first I say it's much easier than you may think; to the second I say: builder beware. You don't want to go through all the trouble and even moderate expense of building a nice antenna support only to have someone show up with a legal order to make you take it down!

## Now The Fun Stuff

After you've determined that you can indeed legally put some steel in the sky, it's time to do the really fun part: planning just what you can do on your specific property. If you own or rent a small city lot, a 200-foot tower may be a little far fetched. If your lot is only 100 feet wide, maybe a 50-foot tower would be more appropriate. Regulations will affect



Or think tall...A PiRod 200-foot commercial tower recycled to ham radio use when the cable company went to fiber optics. This photo also shows some satellite dish antennas.



A Rohn 6 type tower—and the only one tower pictured that's not on the author's property! This kind of tower is suitable for light-duty use only.



this decision, too, since many rules state that the "fall zone" of any tower lie within your own property lines.

Your homework also included researching various types of towers, manufacturers, and materials, and learning about antenna support structures in general. Fortunately, research doesn't cost anything, and—especially if you have access to the Internet—is fun and easy.

## A Few Words On Towers In General

Here's a little tower history to give you a foundation (pun intended!):

Only about 30 or so years ago, television reception was a real challenge in broadcast fringe areas, which prompted the purchase and installation of "TV towers" for better TV viewing—and to get those "blacked out" football games. Now that cable TV and direct-to-home satellite dish antennas have become the norm, many of those old TV towers are going unused. The good news is that they're a perfect source for very low-cost antenna support structures for radio enthusiasts! All you have to do is to go door-to-door asking the owner if he or she would like to get rid of that old TV tower. In many cases, the answer is YES! And the price is usually right: either free or close to it. A small

"Wanted" ad in a local newspaper may also bring in many leads, especially if you can indicate that the old tower would be used for REACT, ARES, or other public service-type operation.

But before you go knocking on doors, you need to know what you're looking for. Most of the early TV towers were what I call a "Rohn 6-type." This refers to a tower with fairly small-diameter tube legs (only about 3/4 inch), horizontal braces between the legs, and no diagonal braces at all. There were a number of companies making them, and several different versions, that were popular in the 1950s. Unless there are some special circumstances, I would *avoid* this type of tower.

Instead seek out something with a somewhat larger diameter leg (about 1-1/4 inches outside diameter) and that has diagonal solid steel braces making a "Z" pattern up the tower. I refer to this design as "Rohn 25G-type," though other manufacturers made similar models. A Rohn 25G tower will free-stand to a height of 50 feet with a reasonable wind load of antennas, and it can be installed with guy wires (at 80-percent of the tower height for maximum strength) to a height of over 150 feet. Yes, you would need to collect a number of TV size towers to come up with a really tall tower like that, but it can be done!

Be aware that Rohn also made a model very similar to the 25G, known as the "20." The Rohn 20 can also be a useful tower,

## Tools Of The Tower Trade, And How To Use Them

You've gotten a good overview of the steps involved, now here's what you need to help you take them:

### Bolt Action

As you're disassembling your discovery, the easiest way to remove the tower leg bolts is with a plain carpenter's claw hammer. Remove the nuts with wrenches, use the hammer to tap the bolt as far as it will go, then use the claw part of the hammer to just pull the bolt out like an old nail.

A word about the bolts: Rohn 25 bolts are galvanized grade 5 fine thread 5/16 and 1/4 inch. If you can save any of them, good, but you'll still have to buy some new ones, so **ONLY** use grade 5 steel bolts! Do NOT use stainless, or grade 8. Stay with what the factory used!

### Clean Up Your Act

Use a wire brush to get any loose scale or rust off the tower sections. In most cases they will need a little touch up. The product to use is "Instant Cold Galvanize" in either spray (much easier) or brush-on form. This is sold in many hardware, auto, and home supply stores.

To make your "new" tower really look new, a very light coating of bright aluminum spray paint (I just use 99-cent-a-can type) will really make it look nice. Or, if you want more of a "stealth" installation, just leave the Cold Galvanize alone. It dries to a nice dull grey that will blend in with the sky and really needs no topcoat.

### Guy Wire Guide

If you decided to put up a guyed tower, the correct guy wire to use would be either 3/16 or 1/4-inch EHS (Extra High Strength) galvanized steel type. A low-cost source of 1/4-inch can be your friendly local cable TV construction crew. Most cable companies use 1/4-inch EHS. (Power and telephone companies use 3/8-inch and larger, which is pretty heavy for a small

tower.) If you're lucky enough to find any cable TV overhead construction work in your area, your odds of getting some of that cable (and the "pre-forms" or "grips" for each end) are pretty good!

You'll need some way to put proper tension on the guy wires. For those really short of money, some of the two- or three-bolt cable clamps used by the cable company as anchor rods could be pressed into service, along with some extra cable clamps for extra security. The best way is to install turnbuckles at each anchor rod. The minimum size would be 3/8-inch high-quality galvanized steel type; 1/2- or 5/8-inch would be better.

There are various types of tension gauges available, but on a small tower the "feel" of the guy wire by an experienced person works about as well as anything. If you're doing your first tower, it's a good idea to hire a tower professional to stop by after your job is done to inspect the whole thing, and have him or her pay special attention to guy wire tension. Most tower specifications call for the tension to be 10 percent of the cable strength, so a 6000-pound cable should be tensioned to 600 pounds. I usually tension smaller towers on the light side to keep down-pressure to a minimum.

If you're unable to obtain guy wire supplies from the local cable company line crew, Texas Towers (<http://texastowers.com/online.htm>) has almost everything you could want for a tower installation, including "Phillystran," a non-conducting, very high-strength material that can be used for guy wires. While Phillystran is fairly expensive, it's *the* way to eliminate the steel guy wires up near the top of the tower if you want to side-mount lots of antennas, or if you want to use the tower itself as an HF antenna.

By the time you calculate all the insulators, pre-forms or cable clamps, and extra labor to install insulators the old-fashioned way, Phillystran turns out to be a pretty good deal. It's also an option that can be easily utilized at a later date if needed.





*A Word of Caution: Pictured here is a Rohn 25G tower, about 12 inches wide. Should you be able to find a similar, or even larger, tower you are very lucky indeed! Rohn also made a slightly larger model, the 35G (also called a Motorola contract tower), which is very rare, as well as a model 45G, a heavy-duty tower. **But be careful:** Rohn also made a lighter-duty model, the "20." The 20 and 25G can be distinguished because the 20 has about 18.5 inches between horizontal "steps" and only seven horizontal bars; the model 25G has eight horizontal braces, and about 15.5 inches between braces. The 25G is rated to a height of about 150 feet when properly guyed; the 20 is only good for very small antennas and a height of about 40 feet! Don't confuse the models!*

but is not nearly as strong as the 25G. See the boxed photo and caption of the Rohn 25G tower for details on how to tell them apart.

## Prior Planning Prevents...

Make sure you've carefully planned out just how you'll be getting that old tower *safely* down and *safely* home. If you have no problem with heights, you might be able to do it yourself (with a helper and a good-quality safety belt!), but if you have no experience climbing you'll definitely need someone who can help you take the tower down.

Hopefully, you've already joined up with people with similar interests from your area, but if not, this is a great time to do so. Join a ham radio club or the local REACT team. Find a friendly tower worker, utility lineman, steel worker, or someone else you could team up with. Be open to looking and asking, and sooner or later it will all come together.

Whatever you do, don't rush it or take any needless chances doing work you're not comfortable with. Tower work can be dangerous! NEVER work on a tower without proper safety equipment, including safety belt or harness, hard hats, and so on.

## Step By Step

So now you've found your tower, maybe a typical 25-year-old Rohn 25G, freestanding model, complete with a rotor at the top and an old television antenna dangling in the wind. Most of these smaller towers have not had proper maintenance, so the leg bolts, especially those near ground level, will be worn, leaving the tower somewhat wobbly. But that's why you got it for free, or close to it!

The way to make those old "loose" joint towers safe is to borrow (or buy) some cable "come alongs" to jack each tower leg tight together again, especially that first, lowest tower leg joint, which is normally the loosest. Once you have done that, you (or your qualified helper) should be able to climb up. If the tower really seems loose, attach some type of temporary guy ropes to help steady it. It's then a simple matter to take the old antenna and mast down and to unbolt the upper tower section.

Borrow or build an erection fixture, or gin pole (a simple piece of pipe with a rope pulley at the top), so the weight of the tower section can be mostly handled by the helper on the ground; experienced tower workers are able to "manhandle" Rohn 25 sections without a gin pole. Factory-made gin poles have fancy clamps to easily attach to the tower legs, but you can use other types of attachments, as long they're sturdy and can handle the weight. Again, don't take any chances with this stuff. Hint: I did it myself years ago—NOT a good idea!

Take it from me, if you're uncomfortable with any of it, don't do it. You might have to dig out a little more money to hire a friendly cable TV guy to stop by with his bucket truck to take the sections down, but it's worth it in the end.

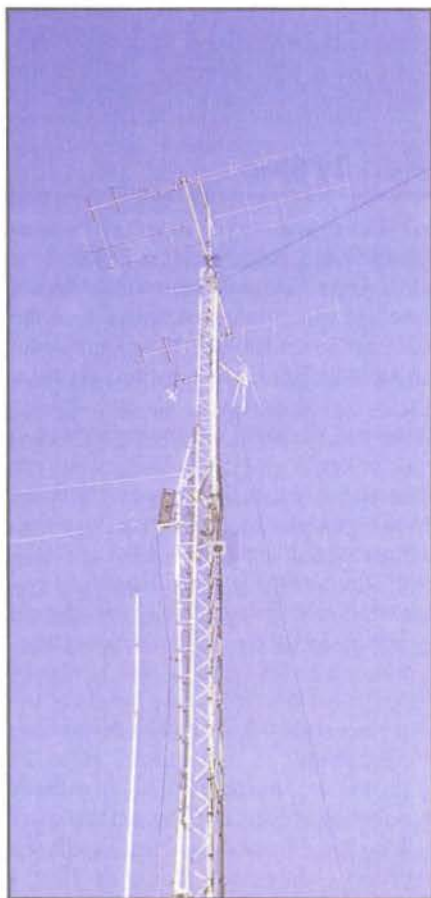
Once all the tower sections are on the ground, you'll have the base left sticking out of the ground in most cases; the installers usually just dug a one-cubic foot hole and filled it with concrete around the first tower section. Just take a hacksaw and cut the legs off as close to the ground as possible. Now you can transport your goodies home. Many of these towers will easily fit in the back of a small pickup truck, but you may need to make more than one trip.

With everything now home, it's helpful to use a pair of saw horses to get the tower sections up at a suitable working height. Sight down each section to make sure it's nice and straight. Look over the bolt holes to see if any are elongated from too-loose bolts. If some holes are badly elongated, I'd recommend using those for a guyed tower only, although some people have drilled out the holes to the next larger size (3/8 and 5/16 inch) with success. If the bolts have "crushed" the legs somewhat where they bolt together, you can take a short section of pipe that just slides inside the leg and "tap" around with a hammer to get them round again.

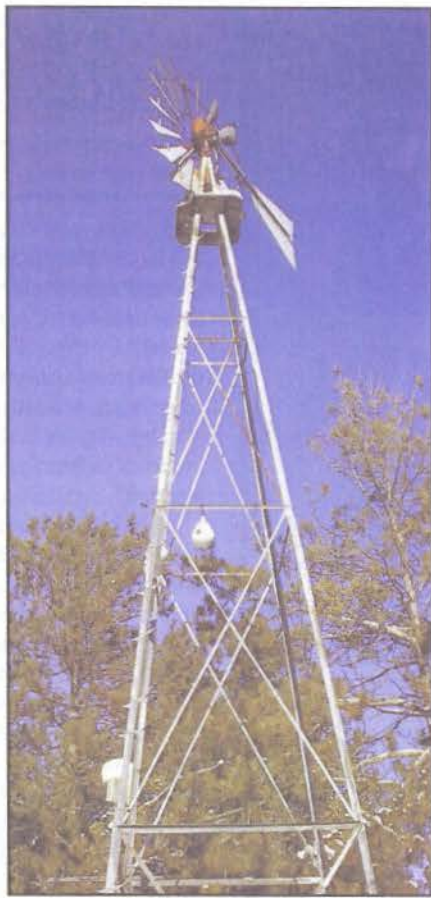
## Location, Location, Location; Foundation, Foundation, Foundation

The location of a tower in relation to your "radio room" is always a compromise. For VHF and UHF it's nice to keep it as close as possible to reduce coax feedline loss. Then again, for





Here's a 65-foot recycled Rohn 25G tower supporting VHF and UHF ham antennas.



An old farm water pump windmill tower recycled into holding up the ends of ham wire antennas.

HF use, and for lightning protection, it's good to have it a reasonable distance from your radio equipment. When you lay out where your tower will go, keep in mind that someday you just might want to make it even higher. Plan ahead for possible guy wire anchor points so you'll have that option in the future, even if right now you're not going to be using guy wires. And don't forget that fall zone, either.

When you're sure where you want the tower, start digging. Rohn specifies a concrete base measuring 4 feet by 4 feet and 4 feet deep. Hand digging is the best way to get it done. If you don't want to, or can't, dig it you then hire some local teenagers. Just remember that the neater the hole, the better. The concrete you'll be putting into the hole needs to be poured against **UNDISTURBED** soil only! **NO** below-grade forms! If you want the concrete to show above grade, you can use a 2X4 form to make the top few inches look neat.

Next, put some gravel in the hole where the tower legs will go, then wrap some tape around the bolt holes of the tower section you'll be putting in the hole, or use the section you hack-sawed off that

has no bolt holes. Put some gravel around the tower legs in the hole to provide drainage so any moisture in the tower legs has a place to escape and won't build up.

If you're going to start out with a guyed tower, also dig the anchor holes at this time, at a distance 80-percent of tower height out from the base for maximum strength. For example, a 100-foot-tall tower should have the anchors 80 feet away from the base of the tower. Actual distance is measured to where the guy anchor rod enters the ground, so the hole and concrete will be a few feet further away from the tower. If you know anyone who works for the local power, phone, or cable companies, galvanized steel anchor rods can usually be recycled from them.

A typical anchor hole for a 100-foot tower would be 3 feet by 3 feet, with 1.5 feet of concrete, buried 4 feet down. Actual dimensions will depend on what your local soils are like. Follow the specs written by Rohn; you can find them at [www.radiancorp.com/ROHNET/rohnet2004/html2004/index.html](http://www.radiancorp.com/ROHNET/rohnet2004/html2004/index.html). You'll need a full cubic yard (at least) of concrete for your tower base, and about another yard for your

anchor holes if you'll be guying this tower. The **ONLY** way to get the concrete is to have the big truck come over! Do **NOT** consider the little sacks of premixed cement and gravel for your tower! Years ago you could save a few bucks by buying the cement, sand, and gravel to mix your own concrete. Those days are long gone. Now the easy, simple, cheap way is to just be ready when the truck comes to pour.

Contact the local Redi-mix concrete people and tell them what you're doing; many concrete jobs have those big trucks heading back to the plant with several yards of concrete left over from some other job. That's the concrete to get! Tell the dispatcher what hours of the day and days of the week you can be available to pour. If you have to order your own, you might be hit with a "small load" extra charge. Try to avoid that! Some areas also have rental places where you rent a small mixer full of concrete—that's another **"TO AVOID."** You need over one cubic yard of solid concrete that will be *strong*. Don't take any chances with the concrete! You want a good strong mixture, with 4000PSI the ideal, but get at least a 3000PSI mix.

Make sure you have some fairly sturdy temporary guy wires or ropes holding the lower two sections of the tower plumb, and check to make sure it stays that way as the concrete is pouring. Then sit back and wait—at least two weeks—before starting to assemble the tower. Concrete reaches well over 80 percent of its ultimate strength in 28 days.

To assemble, just reverse the procedure you used with the gin pole in taking the tower down. With at least two people, it will go fast, and in an hour or two it will be up and finished! Don't forget to take a few pictures as it goes up!

## The Best Part...

If you really scrounge and get many of the supplies as described in this article, you may be able to build that 50- to 100-foot tall tower for \$500 dollars or less! And the same principles apply if you're going for a simple pipe mast or a tripod on your roof. Search around for an old TV antenna setup and "recycle" it before shelling out the big dollars for a brand new installation.

Yes, it can be done—I've done it myself many times and so have others! But even if you can't do it for that low of a price-tag, by following some of these ideas you should be able to build a good tower/antenna support for much less than full retail. The sky's in reach! ■